

Yield and N concentration of 'stay-green' maize hybrids under different N fertilizer regimes

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'Stay-green' (Sgr) maize cultivars have been selected to maintain a high green leaf area during the post silking development phase. Consequently they sustain higher photosynthetic activity than other cultivars at a time of high crop demand (Hay and Porter, 2006). This is critical because the largest proportion of dry matter partitioned to the grain is accumulated after silking (Muchow *et al.*, 1990). Maintenance of green leaf area may also reduce the total nitrogen demand for crops and thus reduce the amount of inorganic fertilizer required.

Methodology

The yield, green leaf area and nitrogen partitioning of four cultivars with 'Sgr' ratings from 6-9 were compared in crops that received 0 or 270 kg N/ha as urea sown in a low N (44 kg N/ha) soil at Lincoln University, New Zealand (43°38'S and 172°28'E). Daily thermal units were accumulated from emergence to maturity (Wilson *et al.*, 1995). Senesced leaves/plant, green leaf area index (GLAI) and total solar radiation intercepted were recorded every 10-15 days while seasonal dry matter accumulation was estimated from 0.3 m² harvests per plot every 14 days. Nitrogen concentration was determined by automated dry combustion-gas chromatography with a Vario Max CN Macro Elemental Analyser.

Results and discussions

Accumulation of biomass and grain yield were increased ($p < 0.001$) by nitrogen fertilizer (Figure 1) but unaffected by 'Sgr'. There were differences among cultivars in the temporal pattern of green area index. At silking (700 °Cd) N increased the GLAI by 42% while 'Sgr' 7 had more GLAI than 'Sgr' 8 and 9 (Table 1). Therefore, during vegetative growth 'Sgr' 7 intercepted 830 MJ/m² of solar radiation or 14% more than by 'Sgr' 8. This early advantage was offset by earlier senescence in 'Sgr' 7, particularly in the absence of N fertilizer. The addition of N delayed leaf senescence during the reproductive phase particularly for 'Sgr' 8 and 9 cultivars (Table 2). In the absence of N fertilizer the 'stay-green' trait was not apparent. At final harvest the 'Sgr' 6 cultivar had the highest grain N content at 1.43% suggesting a greater demand for N from the leaves that accelerated senescence.

Conclusions

Combining the 'Sgr' trait into cultivars with high green area index in the early vegetative phase offers an opportunity for maize yield improvement. The retention of green leaf area in the high 'Sgr' rated cultivars with N fertilization shows a genotype by environmental interaction that could be exploited agronomically. The lower grain %N in high 'Sgr' rated cultivars may be beneficial for creating total mixed rations with plants that have a high protein content.

References

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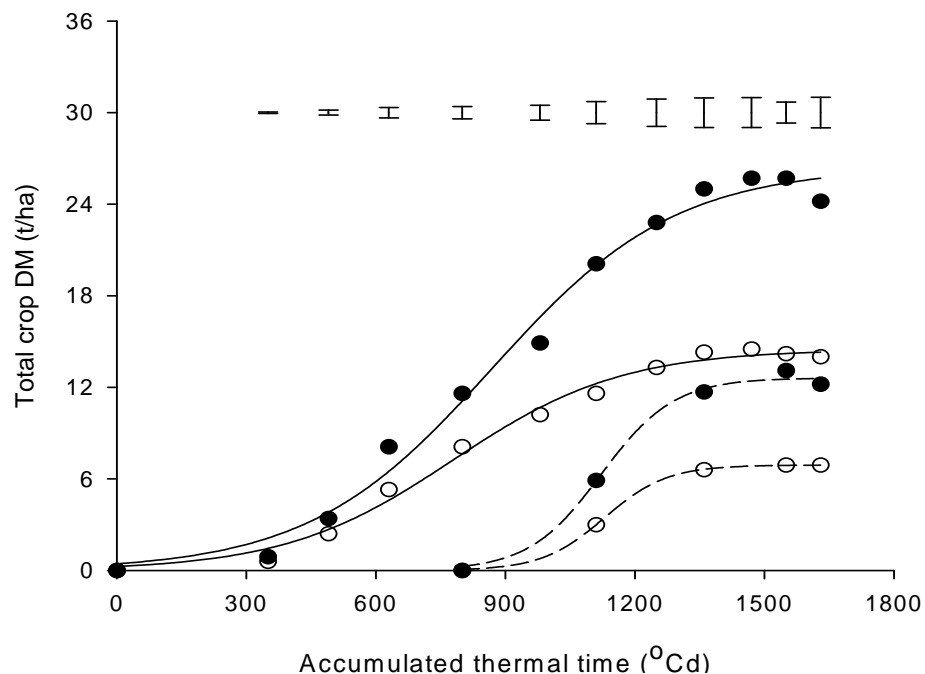


Figure 1. Total crop dry matter (solid line) and seed yield (dashed line) (t/ha) against accumulated thermal time ($T_b = 0\text{ }^{\circ}\text{C}$) for four maize cultivars grown without (\circ) or with 270 kg N/ha (\bullet) at Lincoln University in 2008/09. Error bars are SEM.

Table 1. Green leaf area index in four maize cultivars of different ‘stay-green’ rating grown without or with 270 kg N/ha at Lincoln University during 2008/09.

kg N/ha	Thermal time ($^{\circ}\text{Cd}$)			
	600		700	
	0	270	0	270
‘Stay-green’ rating				
9 (‘P38G43’)	2.4	3.3 _c	3.2	5.2 _b
8 (‘P38F70’)	2.3	3.2 _c	3.5	5.1 _b
7 (‘P38V12’)	2.7	4.2 _a	4.4	6.0 _a
6 (‘P39K38’)	2.7	3.7 _b	4.0	5.1 _b
Significance	p<0.238	p<0.001	p<0.103	p<0.048
LSD	0.47	0.28	0.99	0.69
CV (%)	15.3	6.3	21.8	10.7

Means with letter subscripts in common are not significantly different at $\alpha = 0.05$

Table 2. Number of senesced leaves/plant in four maize cultivars of different ‘stay-green’ rating grown with 0 or 270 kg N/ha at Lincoln University during 2008/09.

kg N/ha	Thermal time ($^{\circ}\text{Cd}$)					
	720		1030		1320	
	0	270	0	270	0	270
‘Stay green’ rating						
9 (‘P38G43’)	6.8	1.6 _b	9.0	3.4 _b	9.6 _a	6.3 _b
8 (‘P38F70’)	6.2	2.8 _a	8.9	4.7 _a	10.0 _a	6.5 _b
7 (‘P38V12’)	6.7	2.5 _a	9.0	5.5 _a	9.6 _a	7.5 _a
6 (‘P39K38’)	6.6	2.4 _a	8.2	4.8 _a	8.7 _b	6.7 _a
Significance	p<0.001		p<0.001		p<0.031	
LSD	0.418		0.810		0.840	
CV (%)	8.0		10.2		8.7	

Means with letter subscripts in common are not significantly different at $\alpha = 0.05$